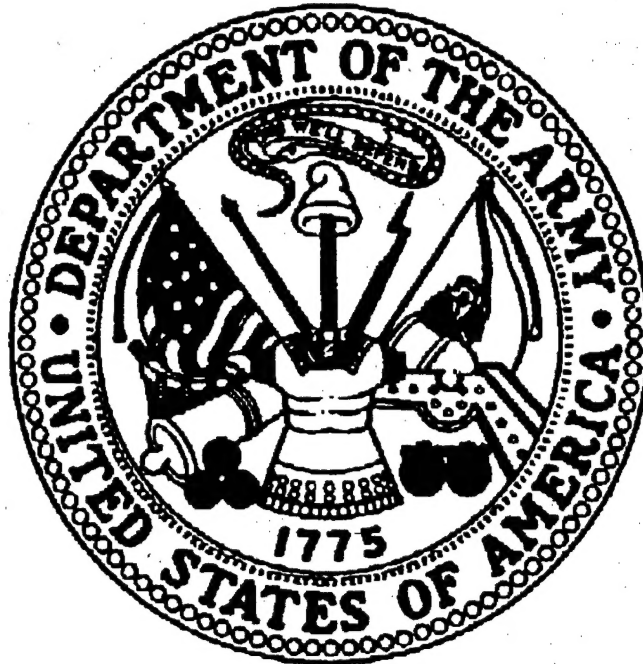


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ARMY MODEL AND SIMULATION

MASTER PLAN

MAY 1994

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703/607-3323 Linda Thomas

Working on obtaining update
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DEPARTMENT OF THE ARMY
OFFICE OF THE UNDER SECRETARY
WASHINGTON, D.C. 20310-0102

3 May 1994



SAUS-OR

The Army Model and Simulation Master Plan contains the Army's vision and corporate strategy to assist in achieving the Defense Model and Simulation Objectives listed below.

Seamlessly link live, constructive and virtual simulations on demand to support the operational readiness of forces.

Apply modeling and simulation both more broadly and with increased validity throughout DoD.

Provide authoritative representations, with appropriate scalability, fidelity and granularity.

Enable interoperability of model and simulation supporting technologies.

As we approach this collaborative effort with our sister Services and members of the Joint and OSD communities, we must invest the precious resources of the Army in an effective and efficient fashion. The approach outlined in this Master Plan provides a blueprint for such investment. It addresses the robust and supportive environment which will allow modeling and simulation technologies to significantly advance the capabilities of a smaller, power projection Army capable of land force dominance. It provides a ready reference for all users, identifying the many Army agencies who have critical roles to play and contributions to make in this endeavor.

This Master Plan does not entertain or support the notion that future model and simulation needs of the Army can be met by a single model or architecture. It requires, however, that we seek opportunities for commonality within the technologies from which model and simulation applications are built and capitalize upon them wherever feasible. This represents a significant departure from past practices, but one which can and must be made.

The transition to the environment described here will require a new paradigm of collegiality throughout the modeling and simulation community. I personally commend this challenge to all of you and ask your assistance in meeting it.

Walter W. Hollis
Deputy Under Secretary of the Army
(Operations Research)

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ARMY MODEL AND SIMULATION MASTER PLAN

Scope

This plan provides guidance for the development and adoption of standards for use in Army Models and Simulations. It represents corporate Army strategy for achieving a modeling and simulation environment but does not provide direct programming instruction.

Although a number of definitions of model and simulation are in common use, for the purpose of this plan, the following definition applies:

Model and simulation: A model of a system is a representation of the system; a simulation is the operation or exercise of the model of the system. The terms "model" and "simulation" are used interchangeably in this document.

Proponency

The proponent for the Army Model and Simulation Master Plan is the Deputy Under Secretary of the Army for Operations Research, ATTN: SAUS-OR, Washington DC 20310. The Functional Manager is Chief, Army Model and Simulation Management Office, ATTN: SFUS-MIS, 1725 Jefferson Davis Highway, Suite 808, Arlington, VA 22202.

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Changes

To help refine future revisions/republications, submit marked up copies to the Functional Manager.

Special Notes

This document is an official Department of the Army publication. It is provided for planning, administration, and operational purposes within the Department of the Army. It does not authorize procurement, nor does it legally or contractually bind the Government for purchase of any goods or services.

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CHAPTER I

INTRODUCTION

Purpose.

The purpose of this document is to promote the adoption of standards, and common tools and processes in building and populating models and simulations (M&S) for use in all applications throughout the Army. The benefits of such investment are greater efficiency, increased interoperability, improved portability, expansibility, extensibility and enhanced credibility for all Army M&S, both those incorporated into the distributed simulation environment and those which remain in stand-alone mode. An ancillary purpose of this Master Plan is to provide ready reference to the multiple players in the Army M&S community. This capability is captured at Appendix C.

Background.

1. Historical Applications.

The U.S. Army has used explicit representations of combat and other processes for various applications for a number of years. The popularity of computer M&S has grown over the past few decades as a direct reflection of the state-of-the-art advances in computer technology. To fully understand the situation which exists today, and to address ourselves to the vision of the future of Army M&S, it is imperative we understand something about our past. M&S have supported a variety of applications which we have, for convenience, grouped into five purposes. A few words about each help in recognizing the complexity of M&S applications.

a. Education, Training, and Military Operations. This application actually captures at least three distinct activities which have been addressed using computer M&S.

(1) Education is a process which takes place in a variety of settings and modalities throughout the Army. The common theme in education is the mastery of competencies (as opposed to tasks, which will be discussed later). Using M&S to educate individuals (organizations are trained, rather than educated) requires a level of representation of combat, or other process being studied, appropriate to the competency being addressed. For example, if students are to master the competency of battlefield effects synchronization, then the M&S used must portray the effects of that synchronization, or its lack, in realistic and convincing fashion. Such an M&S must provide options appropriate to the educational process, but need not include all the M&S functionality necessary to train a staff to execute this same synchronization on the field of battle.

(2) Training, as discussed above, is a related, but distinct process. Army training is defined in terms of individual or organizational tasks performed to standard while the training audience is subjected to conditions realistic to the setting in which the task will be performed in time of conflict or other contingency. Training subjects the audience to the conditions of the battlefield and to the stressors associated with decision making there. The distinction between M&S used to educate individuals and those used to train individuals and/or organizations becomes readily apparent from this definition.

(3) Military Operations present an array of applications for M&S. The most common of these applications are building and analyzing operational plans and orders and mission rehearsal. For these types of analyses, combat or other involved processes must be represented to a level of resolution which will engender extreme confidence in their results. The M&S to satisfy plans analysis must be able to replicate results and permit multiple excursions which implies run times much faster than real time and may allow the exclusion of all human interaction to ensure comparability of results. Heretofore, these applications required quite different M&S than those built for training and education.

b. Analysis. M&S has generally been employed for five categories of analysis.

(1) Macro Force Analyses are strategic level analyses used to determine impacts of decisions on the warfighting capabilities the Army must contribute to the National Security. Among these are: force planning that assesses number, type and component of divisions required (Army Strategic Force Architecture Study) and force structure analysis that assesses number, type and component of Combat Support/Combat Service Support units required to support division force structure (Total Army Analysis). M&S to support such analysis must be capable of representing entire theaters and concurrent contingencies, and answer resource allocation questions. They must be capable of run times much faster than real time, must show consistent results from multiple replications, and must explicitly represent and interrelate the multiple sources of military power.

(2) Micro Force Analyses occur at the tactical end of the operational spectrum and must be supported by M&S which represent fighting system and higher levels of detail. Such analyses include force design that examines organizational unit building blocks for divisions and other unit structures. These M&S, too, must be repeatable and must explicitly demonstrate contributions of various equipment, system performance, organizational structures, training foci, and doctrines/tactics.

(3) Cost and Operational Effectiveness Analyses (COEAs) are a unique application of M&S at both the system level and the force on force perspective to support the materiel development process. COEAs are issue driven, may draw upon a wide variety of analytic tools, and must develop fine cost/effectiveness trade-offs.

(4) Modernization Analyses include three sub elements: requirements analysis that includes requirements development and Operational Requirements Document (ORD) supporting analysis; acquisition milestone supporting analysis that includes COEA plus performance/cost tradeoff analysis; and force level modernization tradeoff analyses such as Value Added.

(5) Other analyses which have benefitted from computer M&S include Recruiting, Training, Personnel, Acquisition, and other Business Practice investigations. The processes which make up the subject environments of these analyses call for M&S which are unique and share little in common with combat or operations other than war M&S.

c. Research and Development. Research and development applications for computer M&S run the gamut from highly detailed analyses of physics based characteristics of proposed systems to significantly less detailed explorations of how emerging technologies might be exploited. Two general groups of effort in this field have been supported by computer M&S in the past.

(1) Research into advanced concepts is best characterized by examining the work being done today in Advanced Technology Demonstrations (ATDs) and Advanced Concept Technology Demonstrations (ACTDs). Such work requires highly reconfigurable simulators and M&S capable of exploring multi-faceted applications of sometimes poorly understood technologies which have not previously been represented using M&S.

(2) Development of weapon systems, on the other hand, requires detailed physics-based representations of component parts and detailed, highly accurate depictions of micro-environments. Such applications have, to this point in time, been addressed using unique, single use M&S, if M&S technology has been applied at all.

d. Test and Evaluation. M&S aid in the accomplishment of objectives of test and evaluation that are otherwise infeasible because of limited resources, environmental restrictions or safety constraints. Test and evaluation cost effectiveness and test realism are the two primary areas M&S enhance.

(1) Testing uses M&S for a variety of purposes such as test scenario development and test item stimulation to replicate operational loading of command and control and intelligence systems. Simulators are used to conduct tests to assess proposed doctrine, tactics, and procedures.

(2) Evaluation of test data and concepts can be performed on a vast array of M&S from engagement level, high resolution through operational (Division and Corps) level. These M&S can be used to assess new technologies, systems with restrictions on environmental and electromagnetic interference, threats that can not be safely replicated, and evaluations of systems that can not be tested in an open arena.

e. Production and Logistics. Production and Logistics represents an area of great M&S growth. M&S are being built upon the efforts of the private sector and the decision tools in the Army's automated information systems. The M&S used in production and logistics often are developed as counterparts to other functional areas, particularly military operations and test and evaluation.

(1) Production applications of M&S complement those used in the test and evaluation functional area. The Army continues to build upon M&S technologies widely used in the private sector, such as Computer Aided Design (CAD) and Computer Aided Manufacturing (CAM), while exploiting new and emerging technologies to support the Army acquisition process and engineer design and manufacturing. System simulations, dynamic simulations, subsystem engineering simulation, engagement models, and performance modeling are among the tools being developed. They are being used to provide technical performance requirements, evaluate design of competitive systems, extrapolate to non-testable conditions, duplicate failure conditions, and to conduct production acceptance testing. The virtual factory and virtual prototyping are being used to improve the manufacturing process, by reducing cycle times in the concept-to-production phases.

(2) Logistics at the national, operational, and tactical levels lends itself aptly to the use of computer modeling. The M&S currently being used often take the outputs from other analytical M&S as their inputs and then demonstrate constraints and efficiencies appropriate to each subset of the logistics structure being addressed. Cost and computing constraints have precluded the development of a single M&S of the national warfighting support structure. For high resolution M&S, logistics data bases can be very large. Most logistics M&S today are constructive.

2. Cataloging.

Having built M&S for the many and varied purposes addressed above, the Army has amassed an impressive array of computer M&S over the past several years. Since the publication of Army Regulation (AR) 5-11, "The Army Model and Simulation Management Program," in 1992, the

Army has brought on line and populated the Models and Simulations: Army Integrated Catalog (MOSAIC). This on-line, hypertext tool is available to all developers and users, and is the first step toward realizing a more efficient M&S environment. Using this tool, potential developers and users of Army M&S have an opportunity to peruse the array of existing M&S and query the hypertext system for all information of interest to them in their proposed application. MOSAIC is the official Army registry of M&S and all active and developmental M&S must be documented there. The System Administrator can be reached at the Army Model and Simulation Management Office (AMSMO) (COML 703-607-3383, DSN 327-3383).

3. Distributed Simulation.

Until as recently as the mid 1980s, practically all the uses of M&S within the Army were developed on an as-needed and as-afforded basis without specific reference to multiple applications or usages. Two primary considerations drove this situation: First, technology was such that each application had to be addressed in isolation, and, second, funding for the various purposes to be supported was separate and distinct. A fortuitous juncture of events in the late 1980s, however, led senior Army decision makers to seriously consider commonality of M&S approaches. The advent of distributed simulation technology, led by the Advanced Research Project Agency's (ARPA's) introduction of Simulation Network (SIMNET), and the downturn in defense budgets have led us to seek applications which simultaneously address more than one of the purposes outlined above. The Army Distributed Interactive Simulation (DIS) Master Plan, 1994, and Army DIS Modernization Plan, 1994, lay out a new look at those purposes and describe a future when many of our needs will, in fact, be sufficed by a single set of technologies and environments. But a perusal of the vision, implementation, and assessment addressed in those documents reveals there remain M&S applications which are unique and will continue to require limited-purpose M&S efforts. Continuing improvements in distributed linkages for constructive M&S to enhance analysis and training applications enable new opportunities to capture and exploit existing capabilities rather than develop new ones. Development and support of initiatives such as the Digitization of the Battlefield provide communication gateways for data linkage with weapon systems.

CHAPTER II

THE OBJECTIVE MODELING AND SIMULATION ENVIRONMENT.

The Army will play a significant role in achieving the four Defense M&S objectives: Seamless Linkages, Broadening Applications, Authoritative Representations, and Enhanced Interoperability. Doing so will require a robust and supportive environment within which Army M&S practitioners work. The shared view of the Army M&S community is of an environment significantly different from that described in the introductory section of this Master Plan, which brought us to the situation we now enjoy. This collective vision is simple and direct and includes the developmental environment in which the distributed simulation applications of the near future will be built. But it also transcends that effort, to encompass every computer M&S effort to be undertaken by, for or with Army agencies. Configuration control of M&S in accordance with policy established by the Directorate of Information Systems for Command, Control, Communications, and Computers (DISC4) will remain critical to an effective and efficient modeling environment. M&S applications across all five application purposes - education, training, and military operations; analysis; test and evaluation; research and development; and production and logistics - and across all activities, to include mobilization, deployment, and operations other than war, will benefit from this vision.

Common Use Models and Simulations.

The first step for any analyst, trainer, developer, tester, logistician, etc., who would use computer M&S technologies to support the mission, must be to survey existing capabilities and select, if possible, an existing tool which can fulfill the mission requirements. Use of MOSAIC and its recently developed Verification, Validation and Accreditation (VV&A) Repository is critical to this effort. The core capabilities realized from our investment in DIS will provide very significant capabilities and must be thoroughly investigated and leveraged for every conceivable application.

Modeling Standards.

Efforts to develop new M&S capabilities, whether as a part of the distributed simulation environment or as stand-alone M&S, will apply standards evolved through a process fostering consensus building, awareness, education, and dialogue across the M&S community. These standards will apply whether the effort is addressed at constructing an entirely new system or is merely a product improvement to an existing M&S.

Reuse of Functionality.

Opportunities are now present for reuse of common treatments of both physical and cognitive processes which are modeled in multiple applications. The establishment of common use repositories, to include software, will enhance our ability to efficiently model both those combat processes with which we are familiar and newly emerging roles of the Army and other services. This does not imply there will only be one standard fashion in which a process must be represented, but rather a set of related treatments scaled and fit to the entire spectrum of requirements. Employing effective methods for the development of assured software and reusing components (where possible) will significantly reduce development costs, improve reliability, and compress development schedules. As the object oriented modeling paradigm becomes customary, reuse of service objects will become the norm.

Data Utilization

M&S data requirements will be identified in accordance with automated information system (AIS) data model development, approval, and maintenance procedures - Information DEFinition (IDEF) Method. The validity and flexibility of M&S are contingent upon standard, certified data. M&S data will be fully integrated with functional data models and requirements and registered in the Department of Defense (DoD) Data Repository System (DDRS). Data will be shared by M&S and with the functional AIS they represent. Data standardization will allow maximum use of data centers and real-time interchange.

Communication Standards.

The community will continue to exploit the evolving communications technologies enabling geographically dispersed M&S the capability to exchange data and interact. New protocols will be established in response to these technologies to evolve forward those developed under DIS and Aggregate Level Simulation Protocol (ALSP). Distributed Simulation will exploit the use of emerging capabilities in both network data communications services and the data exchange standards. Standards for interoperability will routinely be built into future applications.

State-of-the-Art Research

The availability of standards and common practices described above shall not constrain the pursuit of new beyond-the-state-of-the-art research in M&S. Standards for these new technologies will be established after development. The Simulation Technology (SIMTECH) Program focuses on accelerating the development and transfer of emerging M&S technologies in order to improve the art and science of military simulation.

CHAPTER III

STANDARDS DEVELOPMENT.

Standards Development Process.

M&S represent one of the horizontal domains in the Army's treatment of AIS. The process through which M&S standards are developed for this domain is one of evolution and consensus building. For ease of understanding and consistency of discussion, six steps in this process are described here. These six steps are identified as "Tasks" throughout the remainder of this Master Plan. These six tasks must be conducted concurrently and shall not be construed to be sequential in their organization. They build upon one another, however, and so are listed in a specific order. This order does not connote any priority or emphasis.

Task 1: Establish Teaming Arrangements.

This is both an initializing and a continuing task. Teaming arrangements are characterized by inclusion vice exclusion. In some cases, the Army will serve as the lead agency in this teaming, and in some cases not. In all cases, teaming arrangements must reach across bounds of Services, DoD, Government, Industry and Academia. Conferences, workshops, publications, and electronic communications represent some of the traditional means of establishing and maintaining teaming arrangements.

Task 2: Define Standards/Services Required.

A critical early and ongoing task is the identification and refinement of requirements within each sub-domain of M&S. Several processes may be involved, depending on the complexity of the area. They may include canvassing, data calls, independent research, or other techniques. These requirements should be stabilized to the extent possible, but must remain agreed to by wide consensus as other work progresses. This task constitutes the "sub-domain analysis" in the context of Army Information Systems.

Task 3: Develop Technical/Procedural Standards.

The heart of the process is to actually derive, develop and/or evolve the standards, procedures and common practices to which the community will willingly adhere. Maximum use will be made of existing standards and procedures, with the evolution of new standards where existing ones do not meet the requirements. Again, a number of means are available to accomplish this task. The key to success is inclusion and involvement of all members of the concerned community.

Task 4: Achieve Community Consensus.

Given the correct focus on tasks one through three, this task is an included process. It is identified separately, however, to emphasize its importance.

Task 5: Build Repositories.

Common use models, algorithms, software, procedures, and data which ensue from the first four steps must be captured and made available to the widest possible audience to ensure consistent adherence and use. MOSAIC is one such repository, but by no means does it represent the only effective approach to this task.

Task 6: Educate and Assist Modelers/Users.

This task goes hand in hand with task five. There should be no assumption, however, that this task follows sequentially behind the others. It is to be accomplished concurrently and in complementary fashion to all previously addressed tasks.

Standards Categories.

Listed in Table 1 (pages 10 and 11) are the categories of initial effort for which the tasks above will be addressed. This articulation of subdivisions of the "M&S Domain" constitutes the "domain analysis" of that horizontal domain in the context of Army Information Systems. Explicit definitions of these Standards Categories will be an early deliverable in the Standards Development Process. Review and refinement of these categories will be conducted and included in the revision/republication.

Standards Category Coordinators.

Organizations identified in this Master Plan will serve as the recognized Army lead coordinating agencies for each of the Standards Categories identified in Table 1 (pages 10 and 11). They will be responsible for applying resources, within the context of their existing missions, to accomplish the six tasks laid out above. Further, they will lead and coordinate the effort to secure and apply Army Model Improvement Program (AMIP) and Defense Modeling and Simulation Office (DMSO) investments in accomplishing those tasks.

1. Standards Categories Assignment.

Agencies assigned a coordinating role are listed in Table 1 (pages 10 and 11).

Table 1. Standards Categories, Coordinators, and Assessment

Category	Coordinators	Standards	Establish Teaming Arrangements	Define Standards/ Services Required	Develop Technical /Procedural Standards	Achieve Community Consensus	Build Repositories	Educate & Assist Modelers/Users
VV&A Methodologies	TRADOC - TRAC	Amber	+	+				
Data Standards	TRADOC - TRAC/AMC - AMSAA	Amber	+	+	+			
System Services	AMC - STRICOM	Amber	+	+	+			
Environmental Representations	COE/AMC							
Terrain (Static & Dynamic	TEC	Amber	+	+				
Dynamic Environment	ARL (BED)/TEC	Red						
Battlefield Algorithms	AMC/TRADOC/COE/DA Staff							
Acquire	AMSAA/TRAC-WSMR/CECOM (NVESD)	Amber	+	+	+			
Move	WES/ATCOM	Amber	+	+				
Attrit	AMSAA/ARL (SLAD) /D&SABL	Amber	+	+				
Reasoning	BCBL/NSC/ODCSINT	Red	+					
Arm, Fix, Supply, Service	CASCOM/CSSBL/LEA	Amber	+	+				
Communications	CECOM/SS&FG	Red	+					
Operations Other Than War	DA Staff - AWC	Amber						
Strategic Activities	DA Staff							
Mobilization	CAA/LEA/AWC	Amber	+					

Table 1. (Con't) Standards Categories, Coordinators, and Assessment

Deployment/Redeployment	CAA/LEA/AWC	Amber	+						
Warfighting	CAA AWC	Amber	+						
Sustainment	CAA/LEA/AWC	Amber	+						
Cost Representation	ASA(FM) - CEAC	Amber		+		+			+
Distributed Simulation Standards	AMC - STRICOM	Green	+	+		+		+	
Computer Generated Forces	TRADOC - TRAC	Amber	+						
User Interfaces	AMC - STRICOM	Red							

Tasks which have been accomplished are marked with a +.

2. Responsibilities.

Each agency assigned a coordinating role will take on these responsibilities.

a. *Ongoing.* Oversee the process described in the beginning of this chapter as it applies to the assigned Standards Category. Apply mission resources to accomplish this work as appropriate.

b. *Annual.* Solicit AMIP/DMSO project nominations from all Army agencies as they apply to the assigned Category. Prepare an annual report. Append appropriate nominations to the annual report and submit to the AMSMO.

c. *Immediate.* Prepare an initial report including a definition of the assigned Standards Category (For algorithm/activity categories, this must include treatment of countermeasures.), a summary of the work to date, and nominations for FY 95 AMIP and DMSO funding. Submit this report to the AMSMO no later than 1 June 1994.

Assessment of Standards By Category.

1. Classifications.

Classifications of standards to be used in this assessment address the overall health of efforts to standardize M&S treatments of activities in each defined category. They are defined as outlined below.

a. *Green.* Green = Standards development is on track.

b. *Amber.* Amber = Standards are understood, but undeveloped.

c. *Red.* Red = Standards requirements are undefined.

2. State of Standards Categories and Tasks.

The state of Standards Categories and Tasks are shown in Table 1 (pages 10 and 11). For each category, the tasks which have been accomplished are marked with a plus sign (+).

CHAPTER IV

INVESTMENT STRATEGY.

Philosophy.

The philosophy for investing scarce Army resources in the Standards Development Process outlined and assessed above is to allow each Standards Category Coordinator to assess needs within assigned category and forward for the Army Model and Simulation Executive Council (AMSEC) consideration those projects which will have the greatest payoff and are beyond the ability of the Standards Category Coordinator to fund.

AMIP

The Army Model Improvement Program (AMIP) will fund annually those projects addressed to the most critical Army needs, and which show the greatest potential reward.

DMSO

The Army will forward to the Office of the Secretary of Defense (OSD) for potential DMSO funding annually those projects which have the widest applicability across the departments of the DoD, and which are beyond the means of the Army to resource alone.

SIMTECH.

The Army's SIMTECH program will continue as in past years. The focus of this program remains to develop and demonstrate new technologies and techniques and to ensure state-of-the-art environments in Army commands and agencies that will attract and retain highly skilled personnel for M&S research and development. This project call will be announced by separate communication and conducted each year as described in AR 5-11.

CHAPTER V

PLAN IMPLEMENTATION.

Modernization Plan.

An annual Army Model and Simulation Modernization Plan will be published at the beginning of each Fiscal Year to reflect the specific investment to be made in each of the Standards Categories identified above. This plan will be produced as a result of several related activities outlined below.

1. Standards Category Coordinator's Annual Report.

This short (not to exceed 5 typewritten pages) document will recap progress made in the previous and current (to date) fiscal years on the Standards Development Tasks in each Standards Category. It will include a current articulation of standards requirements and an assessment of their status. Appended to this report will be requests for AMIP/DMSO funding of standards development work in this Standards Category. The report for each Standards Category will be submitted by the responsible Standards Category Coordinator. This report will be due each year on 1 April, and will cover all work up to 1 March of that same year. An initial survey assessing conditions on 1 May 94, will be submitted no later than 1 Jun 94. This submission should include FY 95 AMIP and DMSO project nominations. A format for project nominations is at Appendix D. All submissions will be made to the AMSMO.

2. AMSEC Deliberations.

The inputs of each annual report will be reviewed by the AMSEC Working Group during April of each year with recommendations made to the AMSEC in May of that same year. The objective of these deliberations is to codify AMIP investment for the following fiscal year and select those projects for forwarding to the DMSO project call for the upcoming fiscal year. These deliberations for FY 95 will be conducted in June 94. All meetings will be announced by separate communication.

3. DMSO Project Deliberations.

These deliberations will normally be expected to take place in the fall of the year. AMSMO will coordinate Army participation in this process.

4. Modernization Plan Publication.

The AMSMO will incorporate the results of the processes outlined above into the annual Modernization Plan with a target publication and distribution date of 1 October each year.

Revision/Republication of Master Plan.

Over the life of this Master Plan, revision and republication are planned each three years. This initial Master Plan will be reviewed, revised and republished early in FY 95 to influence investment activities for FY 96.

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Army Model and Simulation Master Plan Appendix A

Glossary

Acronyms

ACAT	Acquisition Category
ACTD	Advanced Concept Technology Demonstration
ADS	Advanced Distributed Simulations
AIS	automated information system
ALSP	Aggregate Level Simulation Protocol
AMC	U.S. Army Materiel Command
AMIP	Army Model Improvement Program
AMSAA	U.S. Army Materiel Systems Analysis Activity
AMSEC	Army Model and Simulation Executive Council
AMSMO	Army Model and Simulation Management Office
AOR	Area of Responsibility
ARDEC	U.S. Army Armament Research, Development, and Engineering Center
ARL	U.S. Army Research Laboratory
ARNG	Army National Guard
ARPA	Advanced Research Project Agency
ARSTAF	Army Staff
ASA(FM)	Assistant Secretary of the Army for Financial Management
ATCOM	U.S. Army Aviation and Troop Command
ATD	Advanced Technology Demonstration
AWC	U.S. Army War College
BCBL	Battle Command Battle Lab
BDS-D	Battlefield Distributed Simulation - Developmental
BED	Battlefield Environment Directorate
CAA	U.S. Army Concepts Analysis Agency
CAAN	Combined Arms Assessment Network
CAD	Computer Aided Design
CAM	Computer Aided Manufacturing
CASCOM	U.S. Army Combined Arms Support Command
CB	chemical and biological
CEAC	U.S. Army Cost and Economic Analysis Center

CECOM	U.S. Army Communications and Electronics Command
CGF	Computer Generated Forces
COE	U. S. Army Chief of Engineers, U. S. Army Corps of Engineers
COEA	Cost and Operational Effectiveness Analysis
CSA	Chief of Staff, United States Army
CSSBL	Combat Service Support Battle Lab
CTC	Combat Training Centers
DA	Department of the Army
D&SABL	Depth and Simultaneous Attack Battle Lab
DCSOPS	Deputy Chief of Staff for Operations and Plans
DCSPER	Deputy Chief of Staff for Personnel
DDRS	DoD Data Repository System
DIS	Distributed Interactive Simulation
DISC4	Directorate of Information Systems for Command, Control, Communications, and Computers
DMSO	Defense Modeling and Simulation Office
DoD	Department of Defense
DUSA(OR)	Deputy Under Secretary of the Army for Operations Research
FAMSIM	Family of Simulations
FFRDC	Federally Funded Research and Development Center
GOSC	General Officer Steering Committee
HQDA	Headquarters, Department of the Army
IDEF	Information DEFinition
JSPS	Joint Strategic Planning System
LAM	Louisiana Maneuvers
LEA	U.S. Army Logistics Evaluation Agency
LORA	Level of Repair Analysis
LOTS	Logistics-Over-The-Shore
LSA	U.S. Army Logistics Support Agency
MACOM	Major Army Command
MANPRINT	Manpower and Personnel Integration
MDEP	Management Decision Package
MICOM	U.S. Army Missile Command
MOSAIC	MOdels and Simulations: Army Integrated Catalog
M&S	Model(s) and Simulation(s), Modeling and Simulation

NCA	National Command Authority
NSC	National Simulation Center
NVESD	Night Vision and Electronic Sensors Directorate
OPTEC	U.S. Army Operational Test and Evaluation Command
OSD	Office of the Secretary of Defense
PDU	Protocol Data Unit
PM ACTS	Product Manager for Air Combat Training Systems
PM CAAN	Product Manager for Combined Arms Assessment Network
PM CATT	Project Manager for Combined Arms Tactical Trainers
PM CCTS	Product Manager for Close Combat Training Systems
PM CSTS	Product Manager for Combat Support Training Systems
PM DIS	Project Manager for Distributed Interactive Simulations
PM FAMSIM	Product Manager for Family of Simulations
PM ITTS	Project Manager for Instrumentation, Targets, and Threat Simulators
PM TRADE	Project Manager for Training Devices
POM	Program Objective Memorandum
PPBES	Planning, Programming, Budgeting and Execution System
RDEC	Research, Development, and Engineering Center
SIMNET	Simulation Network
SIMTECH	Simulation Technology
SLAD	Survivability/Lethality Analysis Directorate
SS&FG	U.S. Army Signal School and Fort Gordon
SSDC	U.S. Army Space and Strategic Defense Command
STRICOM	U.S. Army Simulation, Training, and Instrumentation Command
SW	Smart Weapons
TACOM	U.S. Army Tank Automotive Command
TAFCS	The Army Force Cost System
TDSS	training devices, simulations, and simulators
TEC	U.S. Army Topographic Engineering Center
TECOM	U.S. Army Test and Evaluation Command
TES	Tactical Engagement Simulator
TOD	TRAC Operations Directorate
TRAC	TRADOC Analysis Center
TRAC-OAC	TRAC Operations Analysis Center
TRAC-WSMR	TRAC at White Sands Missile Range
TRADOC	U.S. Army Training and Doctrine Command
V&V	Verification and Validation

VV&A

Verification, Validation and Accreditation

WES

U.S. Army Engineer Waterway Experimentation Station

Definitions

Accreditation. An official determination by management that an M&S is acceptable for a specific purpose.

Accreditation Proponent. Two cases: (1) the agency designated to determine an M&S is acceptable for a generic class of applications; (2) the sponsor of a specific application involving the use of an M&S.

Analysis. A broad category of study and investigation which includes support to operational, tactical, and strategic decision making.

Architecture. The manner in which a system or a program is structured. Within M&S it can apply to the operating system (standards and protocols), data base(s), or the operational concept.

Battlefield Distributed Simulation - Developmental (BDS-D). An ongoing Army program to network distributed simulators, constructive simulations, and (if feasible) live simulations (that are instrumented) to support all phases of doctrine and tactics development, training, materiel development, and testing and evaluation.

Communication Standards. A capability/technology that establishes procedures for controlling data traffic between and among simulations/simulators and along LAN/WAN gateways. These encompass both network communications services and data exchange standards.

Computer Generated Forces. A capability/technology where computer generated forces are a doctrinally correct representation of both friendly and opposing forces. These forces will support simulations by providing opposing forces, supporting forces, and forces needed to permit a smaller number of personnel to represent a much larger force.

Configuration. Arrangement of elements or parts.

Configuration Management (CM). The application of technical and administrative direction and surveillance to identify and document the functional and physical characteristics of a model or simulation, control changes, and record and report change processing and implementation status.

Cost and Operational Effectiveness Analysis. A study conducted to provide support for acquisition decisions at each milestone in the acquisition cycle. The COEA compares estimated cost and operational effectiveness of the proposed system concept with existing systems and competing system concepts. It examines technical approaches for satisfying the materiel need and alternative logistics support concepts.

Data Exchange Standard. Formally defined protocols for the format and content of data messages used for interchanging data between networked simulation and/or simulator nodes used to create and operate a distributed, time and space coherent synthetic environment. Current standards are ALSP and DIS PDUs.

Data Standards. A capability that increases information sharing effectiveness by establishing standardization of data elements, data base construction, accessibility procedures, system communication, data maintenance and control.

Dynamic Environment. The environment is constantly changing as a result of man-made efforts (battlefield smoke) and natural phenomenon (weather). Incorporating dynamic environment into real time simulations provides a more realistic test bed for weapons, equipment, and personnel.

Education, Training, and Military Operations. Education covers the teaching of concepts, tactics, techniques, and procedures in a classroom/seminar environment. Training covers skill development at all levels of the spectrum to include exercises, training simulations, and new-equipment familiarization. Military operations includes building and analyzing operational plans and orders and mission rehearsal.

Interoperability. The ability of a set of simulation entities to interact with an acceptable degree of fidelity. The acceptability of a model is determined by the user for the specific purpose of the exercise, test, analysis, etc.

Model and Simulation (M&S). A model of a system is a representation of the system; a simulation is the operation or exercise of the model of the system. The terms "model" and "simulation" are used interchangeably in this document.

M&S Developer. The agency which actually develops an M&S or the agency that is overseeing the M&S development by a contractor or FFRDC.

M&S Proponent. The agency or organization that has primary responsibility for M&S in its area of interest.

M&S User. Those who apply M&S to specific applications.

Network Communication Services. The capability provided to electronically transmit modeling and simulation data between networked computational nodes in a manner which meets requirements for transmission latency, multi-cast addressing and security needed to support the creation and operation of distributed time and space coherent synthetic environments.

Protocol Data Unit (PDU) Standards. Formally defined data exchange standards established for each of the several primary classes of functionality which is represented in the DIS synthetic environment, e. g. movement, weapons, firing effects, collisions, etc.

Research and Development. Scientific inquiry to discover or revise facts and theories of phenomena, followed by transformation of these discoveries into physical representations. For M&S purposes, research and development M&S contribute either directly or indirectly to item level system characteristics and performance data.

Simulation. See "Model and Simulation"

Simulation Network (SIMNET). The Army's network that currently links M1, M2, and Aviation simulators. Referred to as SIMNET-T (for "Training") and SIMNET-D (for "Development") sites. SIMNET-D is also referred to as "Laboratory Nodes (LabNodes)".

Simulator. A physical M&S of a weapons system or piece of equipment that is not a prototype, but which replicates some major aspects of the equipment's operations. It may include elements of imbedded computer hardware and software associated with these operations or the environment immediately impacted by the equipment itself, but which is reactive only to the manipulation of the single piece of equipment. The linking of two or more simulators in a common, interactive scenario gives one kind of a simulation.

Software Interface Standards Development. The development of a standard software interface that allows simulations using different software to communicate with each other. This is done by developing Protocol Data Units (PDUs) that specify the format and structure of data that will be transferred on the DSI. These PDUs standardize simulation output and establish the conversion requirements.

Standard. A rule, principle, or measurement established by authority, custom, or general consent as a representation or example.

Terrain (Static/Dynamic). Dynamic terrain allows for terrain changes to be introduced during a simulation. Examples are engineer efforts, building construction or destruction, weather. Static terrain does not change after simulation has been started.

Test and Evaluation. Test and evaluation includes developmental and operational tests.

V&V Proponent. The agency responsible for ensuring proper V&V is performed on a specific M&S.

Validation. The process of determining the extent to which an M&S is an accurate representation of the real world from the perspective of the intended use of the M&S.

Verification. The process of determining that an M&S implementation accurately represents the developer's conceptual description and specifications. Verification evaluates the extent to which the M&S has been developed using sound and established software engineering techniques.

Army Model And Simulation Master Plan Appendix B

References

Section I. Required Publications.

Department of Defense Directive 5000.59
Department of Defense Modeling and Simulation (M&S) Management, 4 January 1994

Department of Defense Directive 8320.1
Department of Defense Data Administration, 26 September 1991

Department of Defense Manual 8320.1-M
Data Administration Procedures, September 1992

Department of Defense Manual 8320.1-M-x
Department of Defense Data Model Development, Approval, and Maintenance Procedures
(Draft), May 1993

Department of Defense Manual 8320.1-M-1
Data Element Standardization Procedures, January 1993

Army Regulation 5-11
Army Model and Simulation Management Program, 10 June 1992

Chairman of the Joint Chiefs of Staff Instruction 8510.01 (Draft)
Joint Modeling and Simulation Management, December 1993

Section II. Related Publications.

Department of the Army Pamphlet 5-11
Verification, Validation, and Accreditation of Army Models and Simulations, 15 October 1993

Distributed Interactive Simulation (DIS) Master Plan 1994 (Draft),

Distributed Interactive Simulation (DIS) Modernization Plan, 3 March 1994

The Department of Defense Enterprise Model, April, 1994

The Army Enterprise Vision, 20 July 1993

The Army Enterprise Strategy Implementation Plan (Ver. 3.6) (Draft), 8 April 1994

Family of Simulations (FAMSIM) Master Plan (Draft), May 1994

Combat Training Center (CTC) Master Plan, 1 June 1993

Defense Modeling and Simulation Action Plan (Draft), May 1994

Theater Analysis Model Improvement Program (Draft), April 1994

Army Model and Simulation

Master Plan

Appendix C

Roles and Missions of Army Modelers and Users

Modeling and Simulation functions are performed by many Army commands and agencies, and the Model and Simulation (M&S) products are used in support of the broad spectrum of Army missions and functions. This appendix identifies organizations performing M&S functions within the context of the DoD Enterprise Activity Model. (A graphical depiction is at figure C-1.) The Enterprise Model provides a strategic framework and a common understanding of all Department of Defense (DoD) Activities.

1. The first of the four activities in the DoD Enterprise is to establish direction. **Establish Direction:** provide the strategic vision, goals, strategies, requirements, plans and programming resources that are executed in the other three activities. Subordinate activities are: to establish policy, to determine requirements, to develop plans, and to allocate resources.

a. Establish policy assesses the world situation for threats to peace and warfare, establishes strategy and establishes priorities and strategies that guide and direct the definition of requirements. For Army M&S, establish policy is limited to promulgation of policy that governs the use of Army M&S.

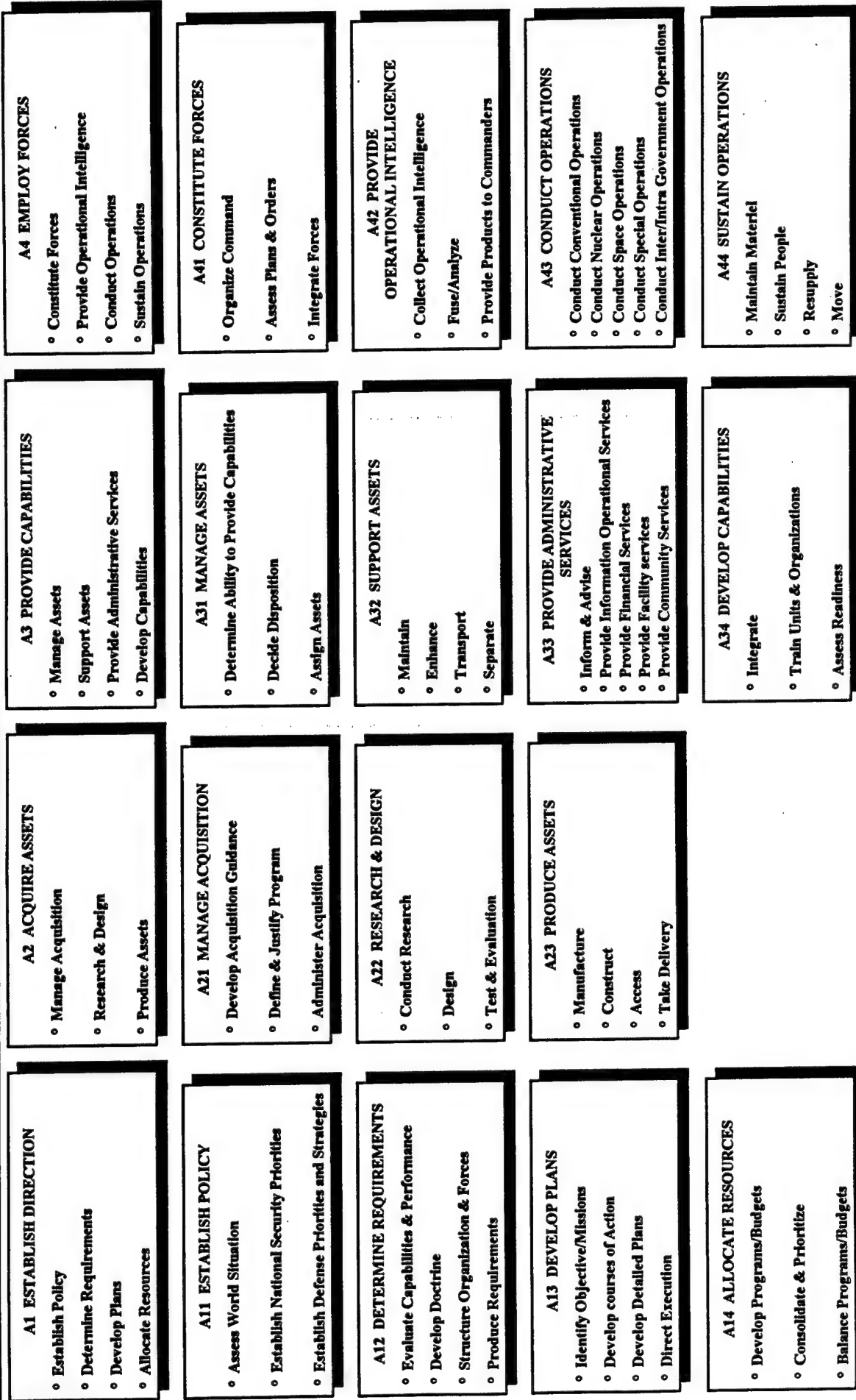
The Deputy Under Secretary of the Army for Operations Research (DUSA(OR)) establishes policy for Army M&S, and procedures and policy to support DoD M&S.

The Army Model and Simulation Executive Council (AMSEC) recommends policy guidance and the Army Model and Simulation Management Office (AMSMO) promulgates Army M&S policy.

The Department of the Army Deputy Chief of Staff for Operations and Plans (DA DCSOPS) establishes policy and direction for the development and application of M&S to support training, exercises, and military operations.

b. Determine requirements assesses the actual capabilities as demonstrated by performance of forces in action and the outcomes of defense programs. For Army M&S, determine requirements includes the use of M&S in the assessment of force performance and the assessment of M&S as a component of the Army mission.

DoD Enterprise Model Overview



The AMSEC establishes the scope of the Army Model and Simulation Program (AMIP) and the Simulation Technology (SIMTECH) Program, approves activities to be included in the AMIP and the SIMTECH Program, and nominates projects/programs for incorporation by the Defense Modeling and Simulation Office (DMSO).

The Distributed Interactive Simulation (DIS) General Officer Steering Committee (GOSC) determines requirements for Army Advanced Distributed Simulation (ADS). The Training and Doctrine Command (TRADOC) Deputy Commanding General is the proponent for and the Army functional manager for DIS. The Commanding General, Simulation Training and Instrumentation Command (STRICOM) is the Army technical manager for DIS.

The DA DCSOPS determines requirements for M&S used to support training, exercises, and military operations.

c. Develop Plans develops military plans and resource/management plans within the context of the Joint Strategic Planning System (JSPS) for war fighting plans and the Planning, Programming, Budgeting, and Execution System (PPBES) for resources. For Army M&S, this activity includes (1) development of M&S plans to provide resource and management plans for M&S Army wide and (2) the use of M&S to develop plans for Army missions.

The AMSMO develops and publishes the *Army Model and Simulation Master Plan* and implementing procedures such as the *Verification, Validation and Accreditation (VV&A) of Army Models and Simulations*.

The Concepts Analysis Agency (CAA), serving as the Center for Strategy and Force Evaluation, conducts analyses of Army Forces in the context of joint/combined forces in support of the Chief of Staff, United States Army (CSA); assists the CSA in decisions relating to strategy, strategic concepts and broad military options; evaluates readiness, capabilities, and requirements for current, programmed, and future forces.

The TRADOC Deputy Commanding General has proponentcy for and develops the Family of Simulations (FAMSIM) and *Combat Training Centers (CTC) Master Plan*.

The National Simulation Center (NSC) is the combat developer for all battle command training simulations.

The TRADOC Deputy Chief of Staff for Analysis is the designated Executive Agent for the *DIS Master Plan*.

The Project Manager for Distributed Interactive Simulations (PM DIS) develops and maintains the Army's *DIS Modernization Plan and MDEP*.

d. Allocate Resources develops resource needs into programs submitted as Program Objective Memoranda (POMs). For Army M&S, allocate resources addresses resource needs of the Army Model and Simulation Management Program and coordinate with the funding programs of the other Services and the DMSO.

The AMSMO publishes guidance and administers the AMIP and SIMTECH Program.

Individual Army Staff (ARSTAF) and Major Army Commands (MACOMs) are responsible for the allocation of M&S resources within their functional area; the DA DCSOPS allocates resources through the POM process to the development and acquisition of M&S.

The TRADOC Deputy Chief of Staff for Analysis coordinates and manages the M&S research program for TRADOC; is TRADOC proponent for M&S policy; is TRADOC staff proponent for the DIS Army Functional Manager; and works with STRICOM to develop the DIS Management Decision Package (MDEP).

The U.S. Army Cost and Economic Analysis Center (CEAC) develops and screens models that pertain to financial management (e.g. cost analysis); designs and implements the cost methodology for Program Office Estimates and Component Cost Analysis that shape the Army Cost Position.

CEAC Forces Team develops and screens models pertaining to force structure costing. The Army Force Cost System (TAFCS) tracks unit cost based on force structure, equipment density, level of training, and geographical area.

CEAC Operating and Support Team develops data bases, cost models, and Cost Estimating Relationships for major materiel systems; tracks operating and support costs; captures demand data and scales it to activity or use; and uses M&S to cost real time sustainment cost during the battlefield simulations.

CEAC Operating and Support Team develops and screens M&S pertaining to manpower costs, and tracks the personnel costs to operate the force.

2. The second of the four activities is to acquire assets. **Acquire Assets:** obtain the products, services, and people needed for Army missions. M&S are used to support Army Acquisition. Secondary activities are to manage acquisition, to research and design, and to produce assets; likewise M&S are acquired or developed.

a. Manage Acquisition defines and promulgates regulation, policies, and procedures; defines procurement; and conducts procurement. For Army M&S, this activity can be of two types: (1) to manage acquisition of M&S and (2) to provide policy and regulate the use of M&S in support of the acquisition of other resources.

The U.S. Army Industrial Operations Command (IOC) (previously the U.S. Army Armament, Munitions and Chemical Command) Cost and Systems Analysis Directorate provides and uses M&S to assess manufacturing, flexible computer integrated manufacturing and repair operations at the macro and micro level within the arsenals, the depots and the ammunition plants.

The U.S. Army Tank Automotive Command (TACOM), Directorate for Cost and Systems Analysis conducts war gaming simulations, develops project planning and system management systems, cost analyses, warranty analyses and economic contract cutbacks.

The U.S. Army Missile Command (MICOM), Integrated Materiel Management Center develops and manages logistics M&S, which can be used to quantify developing technologies to address identified sustainment issues, and provides logistics simulation capabilities to assess the factory-to-foxhole logistics process.

The U.S. Army Communications and Electronics Command (CECOM) develops problem solving methodology programs and artificial intelligence techniques for management applications, and constructs systems, management and logistics analysis models to provide independent objective assessments that help decision makers in choosing a cost effective materiel development, acquisition, and readiness; or an effective management process.

The U.S. Army Aviation and Troop Command (ATCOM), Directorate for Systems and Cost Analysis, the primary command resource in the M&S area, provides to command agencies and activities systems effectiveness studies using M&S; development of in-house M&S as needed; modification and adaptation of models from other sources to fit ATCOM needs; independent verification and validation (V&V) of models developed under contract; and command M&S liaison with other DA and DoD agencies.

The U.S. Army Logistics Support Activity (LSA) develops and manages techniques/models for performing Logistics Support Analysis and Logistics Support Analysis Reports; is responsible for policy, techniques/models and data elements for level of repair analysis (LORA); is proponent, developer and configuration manager of three of the currently designated Army standard LORA techniques/models; performs LORA on designated weapon systems; and provides consultation and guidance on performing LORA on all Army weapon systems.

The U.S. Army Materiel Command (AMC) STRICOM manages the development and acquisition of M&S to support training, exercises, and military operations; in conjunction with TRADOC who represents the users.

b. Research and Design includes the conduct of research, design, and testing to advance the state of the art and to define performance requirements and physical characteristics of assets to be produced. For Army M&S, this activity includes (1) the research, design, and testing to advance the state of the art in M&S, and (2) use of M&S in support of research and design in the materiel acquisition process.

The U.S. Army Topographic Engineering Center (TEC) conducts basic research programs in support of its missions in Combat Engineering to provide soldiers and their commanders with superior knowledge of the battle field so that future Army force projection can be accurate, efficient, and, when required, lethal; conduct basic research in terrain analysis, image processing, photogrammetry, knowledge based systems, data base development, environmental science, spectral photometry and signal analysis, neural networks, terrain visualization, data fusion, and image compression; advances and maintains a technology base that will provide superior technology in support of combat operations through development of terrain-related systems and information in areas which include enhanced visibility, improved selection of vantage points, mobility aids, improved detection of both surface and subsurface hazards and obstacles and facilitate terrain visualization for real-time battle field operation, as well as M&S; research includes the exploitation of full-spectrum remote sensing (including hyperspectral) data, computer sciences, including artificial intelligence, and advanced photogrammetric and terrain visualization techniques.

TRADOC Analysis Center (TRAC), TRADOC's principle operations research activity, sponsors, designs, develops, maintains, and provides configuration management of combined-arms force-on-force M&S; coordinates, manages, and executes M&S V&V for TRAC, TRADOC, and the Army, and TRADOC study-specific accreditation of M&S it sponsors or uses. TRAC is the Army V&V proponent for DIS and is the data standards and data provider for digitized model-ready terrain data and systems performance data.

The TRAC Operations Directorate (TOD) performs staff supervision and development, V&V, configuration control and management, and accreditation of TRAC M&S; prepares, staffs and recommends TRAC policies pertaining to M&S; and, as the single point of entry for requests for M&S from government and industry, reviews requests, recommends release, and coordinates release with reviewing and approving authorities.

The TRAC Study and Analysis Center uses M&S in support of quick-reaction analytical support to TRADOC and HQDA, and in ACAT I and II COEAs, and develops and oversees the TRADOC central data base for combat development studies and analyses.

TRAC Operations Analysis Center (TRAC-OAC) designs, develops, maintains, documents, performs V&V for, and operationally supports state-of-the-art theater / corps / division level combat development M&S; has configuration control and technical lead for selected TRADOC combat M&S. The Modeling and Research Directorate is the research coordinator for TRAC-OAC; provides support in procurement of funds and execution of research programs; and oversees the development of Army standard combat modeling algorithms.

TRAC Monterey applies M&S in conducting applied and developmental research.

The TRAC White Sands Missile Range (TRAC-WSMR) designs, develops, maintains, documents, performs V&V for, and operationally supports brigade and battalion level combined arms combat development M&S; and has configuration control for selected TRADOC combat M&S. TRAC-WSMR uses M&S in performing COEAs; supports M&S training applications; and furnishes support to the model-test-model activities of Army operational testing.

The U.S. Army Materiel Systems Analysis Activity (AMSAA) uses M&S to provide US and threat systems performance data for use in COEAs, in Army studies, and in support of the acquisition of systems; helps to accredit and provides certified systems performance data characteristics and data to the Army community; provides VV&A support to US Army Materiel Command (AMC) and other agencies; promulgates VV&A and data certification policy throughout AMC; and, in conjunction with TRADOC, standardizes data and algorithms within the Army community.

The NSC is the TRADOC's proponent for all battle command training simulations; and sponsors, designs, maintains, and provides configuration management of all Army battle command training M&S and coordinates, manages, and executes training simulation V&V.

The U.S. Army Armament Research, Development, and Engineering Center (ARDEC) uses M&S to examine the operational effectiveness and design characteristics of developmental and existing items included in the mission of the ARDEC and related commands.

The U.S. Army Edgewood Research, Development, and Engineering Center (ERDEC) maintains and documents current versions of the chemical and biological (CB) and smoke cloud-travel and dispersion M&S, and their associated inputs, related to U.S., NATO, and threat weapon systems; develops the basic science and engineering models to describe CB and smoke defensive items and equipment.

The U.S. Army Natick Research Development and Engineering Center develops and applies M&S to support development and evaluation of new concepts for enhancing soldier system capabilities in the areas of survivability, sustainability, and mobility. Commodities in these areas encompass rations, food service equipment, packing, clothing and individual equipment, soldier load bearing equipment, chemical protection items (excluding masks), heads-up displays, airdrop systems and field organizational equipment ensembles included in Force Provider. M&S are used to evaluate user requirements, technical approaches, tradeoffs, and benefits in terms of war fighting capabilities.

The U.S. Army Cold Region Research and Engineering Laboratory uses M&S to investigate the dominant processes that govern the performance of systems or activities in winter and cold regions and to conduct research on mobility, logistics, and sustainment issues that are critical to the military operations in cold and transitional climates.

The ATCOM Applied Technology Directorate conducts M&S to accomplish exploratory and advanced development of rotocraft technologies including constructive engineering and combat simulations, systems level virtual simulations, and live simulations using experimental hardware and software.

The ATCOM Aeroflight Dynamics Directorate develops and demonstrates advanced aviation simulation technology for use in evaluating advanced rotocraft technology and performs system level M&S to evaluate human system interface and systems measures of performance.

MICOM conducts M&S associated with weapon system tactical effectiveness analyses, systems analysis and operations research studies and cost effectiveness analysis and LORA.

The U.S. Army Missile Research, Development, and Engineering Center, Systems Simulations and Development Directorate conducts research, exploratory and advanced development, and provides engineering and scientific expertise in aeroballistics, flight dynamics, aerodynamics, system performance analysis, statistical data and error analysis, system simulation, simulation theory and technology, analog/hybrid computer and interface system technology, math model V&V techniques and real-time time-critical simulation technology; provides facilities and technical expertise for the development, analysis, and operation of missile system simulation, to include digital, analog, hybrid and hardware-in-the-loop simulations, in support of weapon system development programs.

The U.S. Army Missile Research, Development, and Engineering Center, Advanced Systems Concept Office conducts or directs system studies to evolve system concepts in coordination with TRADOC and provides a concept engineering focal point for advance missile, rocket, and directed energy systems; analyzes accuracy predictions and develops performance and cost estimates reflecting operational and threat environments including normal and exceptional usage, countermeasures, and technology system enhancements to offset potential or actual shortfalls.

The AMC Smart Weapons Management Office develops and maintains M&S and methodology used to conduct analytical studies and analysis related to smart weapons (SW).

TACOM Research, Development, and Engineering Center maintains an analytical and physical simulation capability to reduce the time and high cost of conventional military vehicle prototype-base design and development in support of such programs as virtual prototyping and Louisiana Maneuvers (LAM); uses simulation of most aspects of combat and tactical vehicle performance with current emphasis on cross country mobility, ride dynamics, truck/trailer and weapon platform stability structural integrity, and system survivability; maintains physical simulations consisting of man and hardware-in-the-loop motion-based simulations that validate analytical M&S, address man-in-the-loop issues, and determine failure points of a vehicle system or subsystem.

The U.S. Army Test and Evaluation Command (TECOM) develops and supports M&S for vibration and environmental testing; uses M&S for meteorology studies for test planning and to drive simulation targets in moving target simulators; and is developing a virtual test range in support of virtual prototyping and other simulation exercises.

The U.S. Army TECOM Dugway Proving Ground uses and supports cloud transport and dispersion M&S in support of obscurant testing, range operations and data reduction analysis.

The U.S. Army TECOM Electronic Proving Ground uses M&S in support of testing of electronic system; operates the Electromagnetic Environmental Test Facility to model electromagnetic emissions on the battlefield according to established scenarios, stimulating test items; and uses test item stimulators to drive communication systems and simulate tactical traffic in hostile electromagnetic environments.

The U.S. Army TECOM Redstone Technical Test Center uses Program Manager M&S to pre-fly test missions; develops, maintains, and uses models simulating small missile flight for stimulating missile sensors; and uses system models to develop application specific integrated circuits and circuit boards.

The U.S. Army TECOM White Sands Missile Range uses Program Manager M&S for test planning, to assist in real-time data presentation and for data analysis; and performs shock, vibration, and environmental testing support by appropriate data bases and models and uses M&S to determine nuclear environmental effects on systems using data from testing in simulated conditions.

The U.S. Army TECOM Yuma Proving Ground uses M&S to support shock, vibration, and environmental testing; develops M&S of the test ranges to support test planning, real-time data reduction and visualization and data analysis; and uses Program Manager M&S to simulate portions of range testing.

The U.S. Army Operational Test and Evaluation Command (OPTEC) is the Army's lead agent for operational test and evaluation; using M&S throughout the testing process, applies cost effective techniques to situations of limited testability; and incorporates the notion of DIS through the use of constructive and virtual simulations in the live simulations (operational tests) that it conducts

The U.S. Army Operational Evaluation command develops and uses M&S to develop operational test scenarios and to augment operational evaluations of materiel.

The U.S. Army Test and Experimentation Command performs operational tests on materiel using M&S to operationally stress command, control, intelligence and information mission area systems.

The U.S. Army Space and Strategic Defense Command (SSDC) applies M&S in conducting research and development (R&D) of missile defense (MD) simulations.

The U.S. Army Research Laboratory (ARL) has several M&S missions.

The ARL Advance Computational and Information Sciences Directorate performs research into such M&S areas as virtual factory, architecture-independent scenario generation, object-oriented CGF, micro-terrain, and synthetic environments for the individual soldier.

The ARL Battlefield Environment Directorate has the mission to own the weather by advancing the understanding of the atmosphere and its critical relationship to performance of Army systems and operations and to develop, acquire, and integrate new technologies that enable Land force Dominance; and use M&S to develop the capability to simulate and visualize atmospheric conditions and their effects on Army systems and sensors.

The ARL Human Research and Engineering Directorate develops and uses M&S in its program of scientific research toward optimizing soldier performance and soldier-machine interactions to maximize battlefield effectiveness, and to provide MANPRINT leadership to ensure that soldier performance requirements are adequately considered in technology development and system design.

The ARL Materiel Directorate uses and develops M&S to determine the optimum composition, configuration, and process parameters needed to improve materials performance; including modeling effects of the environment, chemical agents, and ballistic impacts on polymer, composite, and armor materials; modeling at the molecular level to predict a compound's or material's characteristics prior to synthesis, with the current emphasis on adhesives.

The ARL Survivability/Lethality Analysis Directorate develops and uses M&S to perform an integrated survivability/lethality/vulnerability analysis of Army systems against the entire spectrum of battlefield threats.

The ARL Weapons Technology Directorate develops and uses M&S to aid in research into energetic materials, armor technologies, directed energy, nuclear effects, and electromagnetic environments; develops tools and performs analyses to assess the battlefield effectiveness of conceptual and developmental weapons systems, including detailed system engineering models up through battalion-level combat simulations; conducts research into innovative simulation methodology, with emphasis on the analysis of new weapon concepts.

c. Produce Assets results in manufactured items unique to DoD requirements; the construction of facilities; and the accession of people for both civilian and military billets. For Army M&S; this activity includes (1) acquisition of Army and DoD unique M&S capabilities and (2) application of M&S to the Army acquisition process.

TRAC is assigned the Army lead for the development of computer generated forces (CGF).

The U.S. Army Construction Engineering Research Laboratories develop corps-wide and theater-wide models of combat engineer command and control, operations, and information management; conduct research in the area of sustainment engineering, particularly theater construction management process; and has developed a flight simulation model for the unmanned aerial vehicle to demonstrate an object oriented framework for use in analysis.

The U.S. Army Engineer Waterway Experimentation Station (WES) Geotechnical Laboratory is responsible for developing, fielding, integration and support of M&S for: describing and predicting the effects of the complex interaction between vehicles and terrain that govern mobility; planning and executing counter-mobility operations; and planning and executing engineer missions relative to repairing, establishing, or maintaining the transportation infrastructure (roads, airfields, airways, etc.) within a theater of operation, to include degradation and deterioration of operating surfaces due to military unique loading.

WES Structure Laboratory is responsible for developing, fielding, integration and support of M&S for: describing and predicting the performance of penetrator munitions into complex manmade and geological materials; describing and predicting the survivability/vulnerability of protective structures (ranging from buried hardened structures to battlefield fighting positions) from the effects of existing and future conventional weapons effects; planning for effective camouflage, concealment, and deception measures for long and medium dwell assets; and describing structural response to structures to demolition munitions.

WES Coastal Engineering Research Center is responsible for development, fielding, integration and support of M&S for: describing, based on historical data, the coastal environment within theater operations for selection of sites best suited for logistics-over-the-shore (LOTS) or amphibious operations; and predicting sea-states during LOTS operations to determine the effects on logistics throughput.

WES Hydraulics Laboratory is responsible for developing, fielding, integration, and support of M&S for: quantifying and predicting the effects of rainfall runoff, dam breaks, and reservoir releases on military operations; describing the potential of inland waterways for movement of watercraft; maintaining a simulator that accurately represents

the performance of watercraft operating in ports and waterways; and managing the DoD groundwater M&S program to determine the subsurface transport of hazardous and toxic contaminants and the most appropriate remedial methods.

WES Environmental Laboratory is responsible for the development, fielding, integration, and support of M&S for: characterizing and visualizing the infrared and millimeter wave background scenes as depicted to weapon systems sensors in temperate, tropic, and arid environments; and characterization, evaluation, and monitoring of DoD sites contaminated with hazardous and toxic materials.

The Office of the Program Executive Office, Aviation ensures current and future Army aviation roles and capabilities are fully realized in the simulation modeling demonstration environment involving both industry and the various Army and tri-service organizations in R&D, operation and training simulation activity.

STRICOM, through its several project and product managers, provides training and test simulation, simulator, target, and instrumentation products and services to develop and sustain war fighting skills, creates synthetic environment to evaluate concepts and support requirements definition, and supports materiel development and test and evaluation; and serves as the Army's Technical Manager for DIS and provides acquisition, type classification, and fielding of Army training devices, simulations, and simulators (TDSS), major test instrumentation, targets, and threat simulators.

The Project Manager for Training Devices (PM TRADE) plans, controls, coordinates, and manages the development, acquisition, and fielding of effective training systems for use by the Army, other Services, and designated foreign and domestic clients; and manages the development, acquisition, and fielding of the instrumentation systems for the CTC and Tactical Engagement Simulators (TES) for use during force-on-force training exercises.

The Product Manager for Air Combat Training Systems (PM ACTS) is responsible for all synthetic flight training systems and all assigned systems for aviation, air defense, and strategic defense training systems.

The Product Manager for Close Combat Training Systems (PM CCTS) is responsible for infantry, armor, anti-armor, combat engineer and special operations forces (SOF) systems.

The Product Manager for Combat Support Training Systems (PM CSTS) is responsible for intelligence/electronic warfare (IEW), communications, field artillery, support/combat service support, and CTC training systems.

The Project Manager for Combined Arms Tactical Trainers (PM CATT) plans, controls, coordinates, and manages the development, acquisition, and fielding of collective task trainers and command and control simulators.

The Product Manager for Family of Simulations (PM FAMSIM) plans, controls, coordinates, and manages the development, acquisition, and fielding of staff command and control simulators.

PM DIS is the DOD lead for DIS; integrates the DIS synthetic environment in support of LAM, Battle Labs, and Research, Development, and Engineering Centers (RDECS); manages the Combined Arms Assessment Network (CAAN); develops and maintains DIS standards and architecture for DoD; and coordinates elaboration of emerging DIS technologies from industry, Advanced Research Project Agency (ARPA), academia, and other research activities.

The Product Manager for Combined Arms Assessment Network (PM CAAN) plans, controls, and manages the use of the CAAN to meet user needs.

The Project Manager for Instrumentation, Targets and Threat Simulators (PM ITTS) Instrumentation Management Office uses M&S for field artillery, operation facilities and in support of Advanced Field Artillery Tactical Data Systems; to simulate pretest and post test conditions of radars and telemetry to support testing of smart and brilliant munitions; to simulate critical command, control, and communications centers with message traffic in support of scenario driven tests; to simulate missile flight dynamics and evaluate seeker tracking and target acquisition on "live" missiles; and to develop threat simulations and simulators to support threat force representation in simulated environments, provides open air testing data for use in simulations, and effectiveness calculations associated with simulations.

PM ITTS Target Management Office uses M&S as a tool to aid in the development of ground and aerial targets; CAD systems to develop and select surrogate vehicles that are used in ground targets and to develop different aspect angles for ground targets; and M&S in serial aerial target development to aid with payload requirements and performance characteristics.

PM ITTS Threat Simulator Management Office is developing simulations of medium and high power threat laser weapons used in an anti-aircraft defense role and manned vehicles featuring optical contrast trackers for target acquisition and tracking; and uses M&S for atmospheric propagation.

3. The third of the four activities is to provide capabilities. **Provide Capabilities:** integrate assets into organizations and units which are developed into ready capabilities to conduct M&S activities and provide M&S infrastructure support to other missions in peacetime, crisis, transition, and war. M&S are used to support the activities to manage assets, to support assets, to provide administrative services, and to develop capabilities; likewise M&S are managed, supported, maintained, and are being developed.

a. Manage Assets controls the allocation of all assets with the Department to organizations, units, or specific inventories. For Army M&S, this activity involves (1) the control or oversight of M&S resources and (2) the use of M&S as a tool in the management of materiel and personnel assets in accordance with peacetime, mobilization and contingency operations.

The Office of the Deputy Chief of Staff for Personnel (DCSPER), Director for Manpower and Personnel Integration (MANPRINT) has oversight for development of M&S for soldier survivability and manpower, personnel and training integration.

The Depth and Simultaneous Attack Battle Lab manages the development, acquisition, and operation of all simulation, simulators and training devices of the US Army Field Artillery School.

The U.S. Army Logistics Evaluation Agency (LEA) is the DCSLOG Executive Agent for logistics M&S including the logistics functional representation in other Army M&S; conducts operations research, systems analysis, cost analysis, and economic analysis; and develops analytical tools and M&S to support ODCSLOG logistics evaluations.

b. Support Assets sustains people, goods, and services necessary to maintain, enhance, transport, and separate assets. M&S are used to support Army and local actions to conduct and evaluate these functions in peacetime and in war. For Army M&S, this activity includes (1) the conduct of activities necessary to effectively use or evaluate the use of M&S and (2) the use of M&S to maintain, enhance, transport, or separate people, goods, or services.

AMSAA maintains configuration control on M&S for item level performance, one-on-one system performance, few-on-few and many-on-many combat and large war gaming simulation.

The TRAC Scenario and Wargaming Center develops and maintains TRADOC standard high- and low-resolution scenarios for the Army tactical and operational war fighting M&S.

The U.S. Army Signal School and Fort Gordon, Combat Developments Directorate maintains high resolution tactical communications simulations for combat developers, which supports the analysis of communications issues including network architecture, and loading current/new doctrine, equipment trade-off, equipment reduction, terrain evaluation and force design.

The U.S. Army Armor Center and School, Directorate of Combat Developments maintains and manages the Mounted Warfare Test Bed; develops and manages constructive and virtual simulation acquisition and modernization projects fielded to the armor force; conducts brigade and battalion level simulation exercise and digitization demonstrations in support of the Fort Knox training missions.

The U.S. Army Combined Arms Center, Battle Command Battle Lab maintains and manages the Battle Command Test Bed for the conduct of experiments in support of the Command and General Staff Officers Course and command post exercises; and maintains simulations to be used in these experiments.

The Dismounted Warfighting Battle Lab provides M&S capability and scenario development in support of analysis, development issues and training for the dismounted battle space; and provides DoD and individual combatant simulation capability.

The Depth and Simultaneous Attack Battle Lab manages the development, acquisition, and operation of all simulations, simulators and training devices for the U.S. Army Field Artillery School; runs M&S in support of COEA studies and in-house and DA directed studies.

STRICOM provides configuration management, life cycle software support, maintenance, operation and transportation of training simulations and simulators; and operates and manages the Battlefield Distributed Simulations, Developmental (BDS-D) sites and develops the BDS-D synthetic environment.

c. Provide Administrative Services involves administrative support to people and other assets, independent of the unique nature of the defense mission. For Army M&S, this activity includes services such as advising and providing administrative management support.

The NSC provides simulation support to other agencies to include technical hardware and software support, data, terrain development, and model documentation, along with exercise support.

TRAC Fort Lee provides logistics M&S support to TRADOC study directors, Combined Arms Support Command, and other commands and agencies; and develops, maintains and performs V&V for logistics M&S.

LEA, as the HQDA executive agent for logistics models, chairs the Logistics Models Working Committee to provide a focal point to identify duplication of modeling activities and model voids, and to promote VV&A.

d. Develop Capabilities entails the assembly, training, and evaluation of personnel and materiel assets into units and organizations that provide capabilities used to perform all enterprise activities. For Army M&S, this activity includes (1) training in the application of M&S, and (2) the application of M&S in training or the organization of personnel or materiel for other missions.

The NSC is responsible for developing, operating, and supporting a family of simulations for joint and combined operations at the tactical, the operational, and the theater level; the simulations portray mobilization, deployment, and redeployment for combat operations, as well as operations other than war.

The U.S. Army War College Center for Strategic Leadership uses M&S in support of students and curriculum of the War College and wargaming, simulation support, and studies and analysis for other Army and DoD commands and agencies at the operational and strategic levels of war; provides limited development of M&S education decision tools.

The Army Special Operations Command Warfighting Center provides computer simulation support to the U.S. Army John F. Kennedy Special Warfare Center and School and its academic programs and to the U.S. Army Special Operations Command and its operational units to enhance analysis, education, training, and operational readiness.

The U.S. Army John F. Kennedy Special Warfare Center and School New Systems Training and Audio Visual Management Branch develops training aids, devices, simulators and simulation requirements in support of unit and resident training.

The United States Army Reserve Command manages M&S used in the training of CONUS based troop program units.

The Army National Guard (ARNG) is the manager for the development of capabilities used in training ARNG units, crews and individual soldiers; develops M&S capabilities for both unit and individual training; and provides a focal point for the development, acquisition, and fielding of training devices.

4. The last of the four activities is to employ forces. **Employ Forces:** to use forces to accomplish assigned missions. The M&S role is to provide enhanced capability to those organizations responsible to defend the nation, keep the peace worldwide, and assist people in need. Generally M&S are used by those forces and agencies with the responsibility to constitute forces, to provide operational intelligence, to conduct operations, and to sustain operations. These users of M&S in turn generate bottoms-up requirements to be satisfied through the development and acquisition of models.

- a. **Constitute Forces** develops and prepares the command structures and the forces in the Area of Responsibility (AOR) that will respond to National Command Authority (NCA) direction to conduct an operation or to perform a joint exercise. Army M&S are used as tools for the force developer.
- b. **Provide Operational Intelligence** identifies specific requirements for managing operational intelligence; collect raw intelligence from a variety of sources; fuses and analyzes the data; distributes finished intelligence products to the Commander, when where and in the form needed to support operations in the field. M&S are included in the tools used to analyze the data and prepare the products for use.
- c. **Conduct Operations** conducts major training exercises and operational missions. M&S are used as the vehicle for mission rehearsal, representing exercise play, and the means to evaluate force readiness or organizational proficiency.
- d. **Sustain Operations** sustains forces in the AOR; maintains materiel, sustains people, provides supplies, moves assets throughout the AOR before operations commence, during execution, and after operations termination. Army M&S are use to assist the combatant commander in achieving mission objectives.

The IOC Cost and Systems Analysis Directorate provides and allies M&S to assess production response and distribution of ammunition from factory and depot to ports in response to contingency operations.

The AMSMO will maintain the media by which to identify and share information on agencies, organizations, and activities in the Army community who use or develop M&S. This material includes information on points of contact. The method of presentation and target media are yet to be determined.

Army Model and Simulation Master Plan APPENDIX D

AMIP/DMSO Project Nominations

Project nominations should relate to one or more of the Standards Categories. Nominations intended for consideration by DMSO for funding will be required to address one or more of the DoD infrastructure objectives. The DoD M&S Objectives as approved by the Director, Defense research and Engineering are:

- i. Seamlessly link live, constructive and virtual simulations on demand to support the operational readiness of forces.
- ii. Apply modeling and simulation both more broadly and with increased validity throughout DoD.
- iii. Provide authoritative representations, with appropriate scalability, fidelity, and granularity.
- iv. Enable interoperability of M&S supporting technologies.

Category Coordinators submitting more than one project should rank their projects.

Each project must have a **ONE** page cover sheet (see attachment) containing the title, executing agency, point of contact, executive summary, and funding profile. Project nominations should be no more than 5 pages in length and contain the following information:

- I Cover Page
- II Background / Description of the Problem
- III Technical Approach
- IV Products
- V Risk / Benefits Analysis

An original and one copy of each project should be sent to:

U.S. Army Model Improvement and Study Management Agency
Crystal Square 2, Suite 808
1725 Jefferson Davis Highway
Arlington, VA. 22202

NOTE: Projects selected and forwarded to DMSO for funding may require a revised submission to satisfy DMSO requirements

STANDARDS CATEGORY PROJECT NOMINATION

PROJECT TITLE: (ACRONYM) and Long Title of the Project

STANDARDS CATEGORY(IES):

POINT OF CONTACT: Executing Agency or Command
Nominated Project Leader
commercial and DSN phone numbers
Facsimile numbers
e-mail address

EXECUTIVE SUMMARY:

Half page description of the project:
work to be performed,
products to be delivered, and
benefits to be derived.

FUNDING PROFILE:

(\$ K)	Prior Funding	FY 95 OMA / OPA	FY 96 OMA / OPA	Project TOTAL
AMIP or DMSO				
Mission Funds				
TOTAL				